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AUTHOR Williams, Gertrude Rebecca
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ABSTRACT

The purpose of this research was to determine whether a computer assisted instruction (CAI) program increased the reading and math standardized test scores for selected sixth grade high risk students in a rural school district. Fifty-four randomly selected students' scores on the Stanford Achievement Test (SAT) Series were compared before and after CAI with the Computer Curriculum Corporation (CCC) software. The students received two 20-minute sessions a week in the CAI lab: Ten minutes were used for math and ten for reading. This particular software provided immediate feedback and allowed students to work at their own pace. The results showed that there was a significant difference in the reading comprehension scores with no difference in the area of math application. The conclusions drawn from this research are that in order for CAI programs to be successful, they must be closely monitored for the individual student's progress and time in the CAI lab, and teachers should be aware of the CAI curriculum in order to help supplement student needs. (Contains 21 references.) (JLB)

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# Efficacy of Computer Assisted Instruction

## In the Areas of Math Application and Reading Comprehension

Gertrude Rebecca Williams

Mississippi State University - Meridian Branch

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Running Head: EFFICACY OF COMPUTER ASSISTED INSTRUCTION

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## Chapter 1 - Introduction

Chester E. Finn (1990) defined education as the "result achieved, learning that takes root when the process has been effective" (p. 586). According to Finn, "education" has happened only when the process is successful. This outcome-based view can be combined with accountability and can be a means of liberating teachers from the traditional definitions of education (Finn, 1990).

Schmoker and Wilson (1993) advocated applying Edward Deming's management principles to education. Deming studied Japanese industry and found a democratic atmosphere, supportive leadership, team and collaborative effort, a clear and unified purpose, and an insistence on regular analysis and evaluation of performance data as a basis for continually improving past practice (Schmoker and Wilson, 1993). Toyota's Total Quality Management program is based on Deming's research. In 1990, Thomas Guskey pointed out that internal assessments such as faculty needs surveys and student test scores should be used to determine appropriate innovative strategies for school improvement programs.

Statement of Problem

In order to achieve higher performance, standards were raised. Increased course requirements for mathematics and science was based on the theory that higher standards, or expectations lead to higher performance of students (Clune, 1989). Clune concluded that higher standards did put more students into basic academic courses, but failed to produce a reasonably uniform education for all students and in conveying higher-order thinking skills necessary for a competitive economy. Another accountability issue was addressed by Selden in 1990. Selden pointed out that low income, minority, and limited English proficient students score significantly lower on achievement tests. He argued that a mathematical formula should be derived to account for the differences between schools, districts, states, or nations.

Because the Chapter I Program is held accountable for improving chapter students' test scores without any method to account for differences, the decision was made by Chapter I personnel to install computer labs and to implement a Computer Assisted Instruction program. The areas of reading and math were chosen to be the areas of concentration for the first year of the Computer Assisted Instruction

(CAI) program and the Computer Curriculum Corporation's (CCC) software program was the software of choice. The purpose of this research is to determine "If the Chapter I CAI program increased reading and math standardized test scores significantly for selected students in a rural school district?"

Justification of Study

As previously stated, the Chapter I program is expected to show gains in SAT scores. Therefore, the program personnel must justify their decisions. Decisions "have little value unless the administration and staff have the skills needed to assess outcomes and program direction" (Schneider, Verdugo, Uribe, Greenberg, 1993). Schneider (et. al.) pointed out that it is unimportant who makes the decisions or how much thought is given to the decision making process as long as there is agreement on the meaning of "quality outcomes." Statistical Product Control (SPC) controls product quality during the production process and should not come into the picture only at the end of the production period during an inspection (Schneider, Verdugo, Uribe, and Greenberg, 1993). This research project is an attempt to look at the "product quality" at the middle of the production process.

Limitations

1. The sample was not representative of the United States population of school children. The sample was not stratified according to sex, socioeconomic status, race, or even age. Therefore, the extrapolation of correlational data to other populations could be in question.

2. The sample size could have been too small to be representative of the general population. No measures of the robustness of the sample were made. Therefore, the limitation is the same as number two.

3. Extraneous variables could have influenced the strength of correlation due to the confounding effects of the computer software program used. Various software programs influence results differently due to their method of instruction.

4. Experimental bias could have been injected by the software program vendors' training of lab personnel. Positive expectancy effects could have been produced during the training of lab personnel which may have affected the outcome.

5. The maturation process of the students as they moved from

the fifth to the sixth grade could have influenced the data.

6. Two fifth grade regular education classroom teachers moved from the fifth grade level to the sixth grade level along with the students. The strengths and weaknesses of these teachers and their methods of instruction could have influenced the data.

Definition of Terms

1. Stanford Achievement Test: provides comparable measures of performance in different school subjects, evaluated in terms of a single normative group (Anastasi, 1968).

2. Normal Curve Equivalents (NCE): are based on even distributions and can be added, subtracted, and averaged in order to make comparisons.

3. Achievement tests: can constitute an important part of remedial teaching programs. They can be useful in the identification of pupils with special educational disabilities and in the measurement of progress in the course of remedial work (Anastasi, 1968).

4. Chapter I: a federally funded program which is designed to help enable at-risk students to function at the same level as other students.

5. At-risk students: students who are at-risk of failing and/or dropping out of school due to learning, socialization, or emotional problems. By identifying and helping these students early in their educational careers the long term costs of supporting these students can be decreased.

6. Reading comprehension: the cognitive ability to understand the information which has been read.

7. Math application: the ability to use mathematical skills in problem solving situations.

8. Computer Curriculum Corporation (CCC): was founded in 1967 by Dr. Patrick Suppes of Stanford University. It is currently owned by the Simon and Schuster Technology Group. It was the first CAI company to serve schools. The courseware provided by the company is research based. CCC is the only learning system with results recognized by the U.S. Department of Education.

9. Computer Assisted Instruction: a method of teaching and learning which involves the use of computer technology.

## Chapter 2 - Review of the Literature

Student motivation, attitudes, and interests in subject areas can be improved with CAI. Computer use positively effects students' attitudes toward school learning and toward specific school subjects (Rieth, Bahr, Polsgrove, Okolo, and Eckert, 1987). These students usually score higher scores on standardized tests, and seldom score lower (Thomas, 1979). The immediate effect of technology on classroom instruction seems to be an increased involvement on the part of the teacher and more enthusiasm from the students (Cohen, 1986).

Research which has studied CAI with at-risk students has had positive results. According to Braun (1990) technology in the hands of trained teachers is especially powerful when used with at-risk students. Braun also found that CAI can be used to help reduce the dropout rate. By reducing the dropout rate and better preparing graduates, Braun speculated that the cost for the technology needed to improve the learning experiences of all students will be at no added cost to the nation.

Social interaction of students can be improved through CAI. In 1989, Fisher found that learning conditions linked to empowerment, a

feeling of having control over one's own environment, are often prevalent in classrooms with high accessibility to computers. Bialo and Sivin (1990) stated that microcomputers are effective in improving students self esteem. Podmore and Craig (1989) found that microcomputers may enhance young children's socialization skills.

Comparisons between technology-based instruction and more traditional approaches have found that technology-based approaches to be more effective (Bialo and Sivin, 1990). Bialo and Sivin (1990) stated that the effectiveness of educational technology depends on a match between the educational goals, learner characteristics, the design of the software, and instructional decisions that affect how the technology is used in schools. Another consideration in technology use is equity. Equity in school computer use must involve not only equal access, but must also consider the learning needs of the poor, minority, and female students (Sutton, 1989).

## Chapter 3 - Methods and Materials

### Procedures

In compliance with Mississippi State University policy , an application to the Institutional Review Board for the Protection of Human Subjects in Research (refer to Appendix A). A letter was submitted to Mr. Anthony Cross, Chapter I Instructional Supervisor, and to Mr. Alfred Mitchell, Chapter I Director, notifying them of the study's purpose and requesting permission to conduct the research (refer to appendix B). Both communications were received and approved (refer to Appendix C).

### Methodology

This study is an experimental study which involved the use of CAI through the Chapter I program in an effort to improve the standardized test scores of Chapter I students. The data was collected as statistical compilations at the end of each school year in 1992 and 1993 using the NCE scores from the Stanford Achievement Tests. These scores were matched for 54 students in the areas of Reading Comprehension and Math Application. Therefore, cause and effect inferences can be extrapolated from the data.

Subjects

The subjects in this study were 54 sixth grade Chapter I students at Livingston Junior High (LJH). The sixth grade was randomly chosen. The majority of students at LJH receive free lunches. The Chapter I program personnel plan to request that LJH be designated as a Chapter I school-wide project within the next two years. Since over 70% of the students receive free or reduced lunches, LJH qualifies for this designation. School-wide designation would qualify all students at LJH to receive the benefits of Chapter I services. Over 90% of LJH's students are minority students and many would be classified as at-risk students due to the level of poverty in the county.

Instrument

The evaluation instrument used in the study was the Stanford Achievement Test (SAT) Series, Eighth Edition, Form K. The SAT is a battery of tests which provides profiles of scores on individual subtests or in major academic areas. The SAT permits horizontal and vertical comparisons. "Thus, an individual relative standing in different subject-matter areas or educational skills can be compared in terms of uniform normative sample" (Anastasi, 1988).

From the overall SAT scores, this study used the Normal Curve Equivalent (NCE) scores in the areas of Math Application and Reading Comprehension to make vertical comparisons of each student's progress. The SAT also provides testing in the area of language. The Chapter I program only provided CAI instruction in the areas of math and reading; therefore this study will only compare NCE scores in these two areas. The 1992 and 1993 SAT scores were based on Normative Data derived in 1989 by Harcourt Brace Jovanovich, Incorporated.

The SAT batteries are administered under strict supervision using standard conditions nationwide. The tests are also closely monitored for security reasons so that no personnel nor students are given unfair advantages. The tests are scored by computers.

Materials

The Computer Curriculum Corporation's software was chosen to be used in the CAI lab at LJH. The lab was composed of 24 stations (one of the largest CAI labs in the state of Alabama). Elementary and junior high students were scheduled for 20 minute sessions two days per week. Ten minutes were used for math and ten minutes for reading. The screens were color monitors. The software provided sound effects.

graphics, and constant stimulation.

As with many effective CAI methods, the CCC software provided immediate feedback, allowed students to work and progress at their own level, varied the amount of response time, provided up-to-date analysis of individual and class progress, and claimed to provide a 70% to 80% success rate (Gross,1992).

The lab teacher was trained by CCC personnel. She constantly monitored students in order to reduce frustration levels. Students were given achievement certificates to take home. At the end of each lab session, each student completed a progress report to take back to the classroom.

## Chapter 4 - Results and Discussion

Did the Chapter I CAI program increase the reading and math standardized test scores significantly? To answer this question, a One-Way analysis of variance was used to analyze the data. The pretest was the NCE scores for 1992 and the post-test was the NCE scores for 1993 of sixth grade students in the Chapter I program at LJH (refer to Appendix D for individual NCE pretest and post-test scores).

The One-Way analysis of variance for 1992-1993 is shown in Table 1.

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Insert Table 1 about here

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The results yielded an F Ratio of 3.5353 and an F probability of .0007 which was significant at the .05 level of probability in the area of Reading Comprehension; and an F Ratio of 1.2738 and an F probability of .2631 which was nonsignificant at the .05 level in the area of Math Application. Reading Comprehension scores are shown in Appendix D and revealed a significant difference between the pretest and the post-test administrations. The significance of the F probability in Reading

Comprehension could have occurred due to the following:

1. The 1991-1992 Chapter I program primarily used certified Chapter teachers who could have given the students a strong reading background and created a positive attitude toward reading.

2. The CCC software could have been viewed by students as a fun game and therefore increased their level of motivation.

3. The CAI lab could have been viewed as a fun and unintimidated atmosphere in which students enjoyed working at their own pace at their own level of ability.

4. The rewards of certificates and grade sheets upon completion of sessions may have motivated students to do their best.

These results agree with Kulik's (1981) findings in which he stated that "The drill and practice apparently kept children interested and actively responding."

The nonsignificance of the F probability in the area of Math Application may have occurred due to the following:

1. Students may not have had a concrete foundation in math in order to be able to move toward the more abstractness which is required at the sixth grade level by a CAI program.

2. Students may not have previously learned the knowledge or concepts which was required of them in order to answer the CAI math questions.

3. The CCC software may not have been the most appropriate software for these students.

4. Because the CAI lab was not opened until November of 1992, and because of the limited amount of time in the CAI lab each week, the students may not have had the benefit of enough time in the CAI lab.

5. The sixth grade teachers may not have made themselves aware of the CCC software and its curriculum and therefore may not have coordinated their program with the CAI program.

These results agree with Kulik's (1981) research which stated that elementary school students may need more feedback, more individual contact, and more guidance than the self-paced systems may provide. These results disagree with Roblyer's (1989) findings that computer applications yield the highest effects in science and math. The CCC recommends 20 minutes of instruction in each subject four days a week which supports the theory that not enough lab time was allowed.

## Chapter 5 - Summary

The Technology for Education Act of 1993 aims to make the federal government a catalyst for improving student achievement by providing students with access to modern technology by linking elementary and secondary schools to powerful telecommunications and computer networks (Rathke, 1993). For this federal effort to be successful, it is imperative that we have teachers who are skilled at structuring effective learning environments and who are flexible in the roles they will play (diagnostician, lecturer, tutor, manager, or facilitator) (Bialo & Sivin, 1990). In addition, the educational goals of learners, learners' characteristics, appropriately designed software, and instructional decisions must all be carefully considered in when making curriculum plans in the use of technology (Bialo & Sivin, 1990).

Federal dollars, teacher training, and school involvement are not enough. According to Schneider (et. al.,1993) there must also be formative and summative self-evaluation and analysis of curriculum changes based on data which is collected frequently. This evaluation process will make it possible for educators and community members to make informed and meaningful decisions in their efforts to produce high

quality students (Schneider, et. al., 1990). The area of technology is exciting, but without evaluation and accountability educators may lose track of their real goals. For example, students' preferences for computers declined significantly as did their perceptions of learning from the technology during a three year study (Kendl & Broihier, 1991). Kendl and Broihier (1991) warned that as the technology becomes more familiar its novelty wears off and students' outcomes will decline. The instructional method can also inflate outcomes (Kendl and Broihier, 1991).

For CAI programs to be successful, they must be closely evaluated. Individual student's progress should be monitored in order to insure that CAI is appropriate for each student. One student may benefit from CAI in math but not in reading, while another student's needs may be the opposite. The time spent in the CAI lab must also be evaluated. A student who seems to benefit from CAI but is not showing significant gains may need more lab time. Regular classroom teachers must also be involved in this evaluation process. They must be aware of the CAI curriculum in order to help supplement their students' needs. The lack of significant math scores may have been prevented with this type of

involvement. One method of involving regular classroom teachers would be to provide CAI training in the Chapter I labs for the teachers. By walking teachers through the programs their students will be using, a sense of understanding of the CAI program and a sense of empathy for the students could be created. In summary, due to the variable nature of the effects of CAI all instruction should be individualized to meet the needs of each student.

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STANFORD ACHIEVEMENT TEST NCE SCORES

Sixth Grade Chapter I Students

| | Reading Comprehension | | Math Application | |
|---|---|---|---|---|
| Student | Pretest | Post-test | Pretest | Post-test |
| 1 | 23.0 | 48.4 | 35.1 | 33.7 |
| 2 | 39.0 | 37.1 | 52.1 | 51.1 |
| 3 | 33.0 | 35.8 | 33.0 | 18.9 |
| 4 | 34.4 | 39.0 | 33.0 | 52.6 |
| 5 | 21.8 | 37.1 | 35.1 | 52.6 |
| 6 | 21.8 | 34.4 | 56.4 | 57.0 |
| 7 | 27.2 | 24.2 | 30.7 | 24.2 |
| 8 | 28.2 | 29.1 | 30.7 | 18.9 |
| 9 | 23.0 | 48.4 | 56.4 | 43.0 |
| 10 | 23.0 | 34.4 | 44.7 | 45.2 |
| 11 | 49.5 | 51.6 | 42.5 | 47.4 |
| 12 | 27.2 | 30.7 | 26.3 | 31.5 |
| 13 | 28.2 | 35.8 | 54.2 | 29.1 |
| 14 | 27.2 | 24.2 | 29.1 | 29.1 |
| 15 | 35.8 | 10.4 | 54.2 | 27.2 |
| 16 | 18.9 | 29.1 | 35.1 | 39.6 |
| 17 | 40.1 | 29.1 | 51.2 | 33.7 |
| 18 | 33.0 | 29.1 | 42.5 | 33.7 |
| 19 | 13.1 | 30.7 | 52.1 | 35.8 |
| 20 | 10.4 | 28.2 | 30.7 | 27.2 |
| 21 | 41.9 | 50.0 | 29.1 | 35.8 |
| 22 | 10.4 | 57.0 | 26.3 | 63.5 |
| 23 | 39.0 | 32.3 | 29.1 | 31.5 |
| 24 | 52.1 | 55.3 | 35.1 | 41.3 |
| 25 | 15.4 | 13.1 | 20.8 | 27.2 |
| 26 | 28.2 | 10.4 | 29.1 | 18.9 |
| 27 | 40.1 | 17.3 | 33.0 | 31.5 |
| 28 | 31.5 | 41.9 | 65.6 | 39.6 |
| 29 | 15.4 | 18.9 | 46.8 | 31.5 |

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|---|---|---|---|---|
| 30 | 15.4 | 46.8 | 26.3 | 69.3 |
| 31 | 43.0 | 32.3 | 24.2 | 27.2 |
| 32 | 34.4 | 32.3 | 50.4 | 33.7 |
| 33 | 33.0 | 40.1 | 44.7 | 41.3 |
| 34 | 29.9 | 41.9 | 46.8 | 41.3 |
| 35 | 37.7 | 30.7 | 26.3 | 21.8 |
| 36 | 28.2 | 37.1 | 30.7 | 35.8 |
| 37 | 34.4 | 29.1 | 21.8 | 54.8 |
| 38 | 37.7 | 43.6 | 48.4 | 54.8 |
| 39 | 39.0 | 30.7 | 50.5 | 35.8 |
| 40 | 37.7 | 32.3 | 35.1 | 21.8 |
| 41 | 15.4 | 24.2 | 26.3 | 59.3 |
| 42 | 31.5 | 35.8 | 39.0 | 39.6 |
| 43 | 31.5 | 41.9 | 62.9 | 81.1 |
| 44 | 15.4 | 21.8 | 14.7 | 15.4 |
| 45 | 39.0 | 34.4 | 56.4 | 47.4 |
| 46 | 25.3 | 6.7 | 35.1 | 29.1 |
| 47 | 21.8 | 34.4 | 56.4 | 43.0 |
| 48 | 31.5 | 24.2 | 30.7 | 15.4 |
| 49 | 41.9 | 40.1 | 52.1 | 52.6 |
| 50 | 27.2 | 35.8 | 24.2 | 57.0 |
| 51 | 28.2 | 24.2 | 33.0 | 57.0 |
| 52 | 39.0 | 39.0 | 30.7 | 37.7 |
| 53 | 18.9 | 24.2 | 46.8 | 33.7 |
| 54 | 44.7 | 32.3 | 21.8 | 35.8 |

X = 29.8759 X = 32.9426 X = 38.4519 X = 38.7778

Table 1

A Comparision of the Pretest and Post-test NCE Scores of the Stanford Achievement Test for Sixth Grade Chapter I Students

| | F Ratio | F Probability |
|---|---|---|
| Reading Comprehension | 3.5353 | .0007 * |
| Math Application | 1.2738 | .2631 |

*Level of significance was found at the .05 level.